JPRS 68182

8 November 1976

USSR

TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY
PHYSICAL SCIENCES AND TECHNOLOGY
No. 3

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

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BIBLIOGRAPHIC DATA SHEET	1. Report No. JPRS 68182	2.	3. Recipient's Accession No.

4. Title and Subtitle
TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY - PHYSICAL SCIENCES AND TECHNOLOGY No. 3

5. Report Date
8 November 1976

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Joint Publications Research Service
1000 North Glebe Road
Arlington, Virginia 22201

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address

As above

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstracts

The report contains information on aeronautics; astronomy and astrophysics; atmospheric sciences; chemistry; earth sciences and oceanography; electronics and electrical engineering; energy conversion; materials; mathematical sciences; cybernetics, computers; mechanical, industrial, civil, and marine engineering; methods and equipment; missile technology; navigation, communications, detection, and countermeasures, nuclear science and technology; ordnance; physics; propulsion and fuels; space technology; and scientists and scientific organization in the physical sciences.

17. Key Words and Document Analysis. 17a. Descriptors

USSR
Aeronautics
Astronomy
Astrophysics
Atmospheric Sciences
Chemistry
Computers
Cybernetics
Earth Sciences
Oceanography
Electronics
Electrical Engineering
Energy Conversion
Materials
Mathematics
Mechanical Engineering
Civil Engineering
Industrial Engineering
Marine Engineering
Methods
Equipment
Missile Technology
Navigation and Communications
Detection and Countermeasures
Nuclear Science and Technology
Ordnance
Physics
Propulsion and Fuels
Space Technology

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group 01,03,04,07,08,09,10,11,12,13,14,16,17,18,19,20,21,22

18. Availability Statement
Unlimited Availability
Sold by NTIS
Springfield, Virginia 22151

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 47

22. Price

FORM NTIS-35 (REV. 3-72)

THIS FORM MAY BE REPRODUCED

USCOMM-DC 14952-P72

JPRS 68182

8 November 1976

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CONTENTS

PAGE

THE AVK-2 ANALOG COMPUTER COMPLEX

Unknown AVK-2 ANALOGOVYY VYCHISLITEL'NYY KOMPLEKS in Russian 1972 signed to press 1 Mar 72 pp 1-20

[USSR Radio Industry Ministry Brochure describing the AVK-2 Analog Computer Complex, 500 copies, 20 pages]

[Text] The AVK-2 second generation analog computer complex is produced in five analog computer models:

AVK-2 (1) -- Model 1;
AVK-2 (2) -- Model 2;
AVK-2 (3) -- Model 3;
AVK-2 (4) -- Model 4;
AVK-2 (5) -- Model 5.

The AVK-2 equipment is designed for modeling dynamic systems, solving ordinary linear and nonlinear differential equations, and other problems which can be reduced to systems of ordinary differential equations.

Model 1 provides for the solution of up to 20th order differential equations with complex nonlinear functions, with constant and variable coefficients.

Model 2 provides for the solution of up to 20th order differential equations with a large number of constant coefficients.

Model 3 provides for the solution of up to 16th order differential equations with constant and variable coefficients, with a large number of nonlinear operations, as well as the solution of various problems by iteration methods*

Model 4 provides for the solution of up to 10th order differential equations with a large number of variable coefficients.

Model 5 provides for the solution of up to 80th order differential equations with constant and variable coefficients, with an extremely large number of nonlinear operations, as well as the solution of various problems by iteration methods*.

* Problems in linear programming, equations in partial derivatives, etc.

Models 1, 2, 3 and 4 are single section types (see Table 1).

Model 5 consists of five Model 3's and the peripheral equipment.

The presence of reliable, plug-in, non-ferrous jack fields with shielded, reparable jack cords and interchangeable functional modules (see Table 2) in the models provides for a rapid transition from one problem to another.

The control circuitry for the models differs in flexibility and makes it possible to perform one-time and repetitive operation solutions, as well as the simultaneous and individual triggering of the integrators by groups.

The monitor circuitry permits checking the normalcy of the operational amplifiers and the power supplies, as well as checking the correctness of the problem set-up and the correctness of the setting of the constant coefficients without reswitching the solution circuits on the jack fields of the analog units.

The operational amplifiers and power supplies are protected against short circuits to ground and through each other.

The thermostat control and ventilation system has a low noise level and assures a constant temperature in the cabinet of the model with the functional modules with an error of no more than ±1° C, which makes it possible to obtain a high degree of stability and repeatability in problem solution in the model.

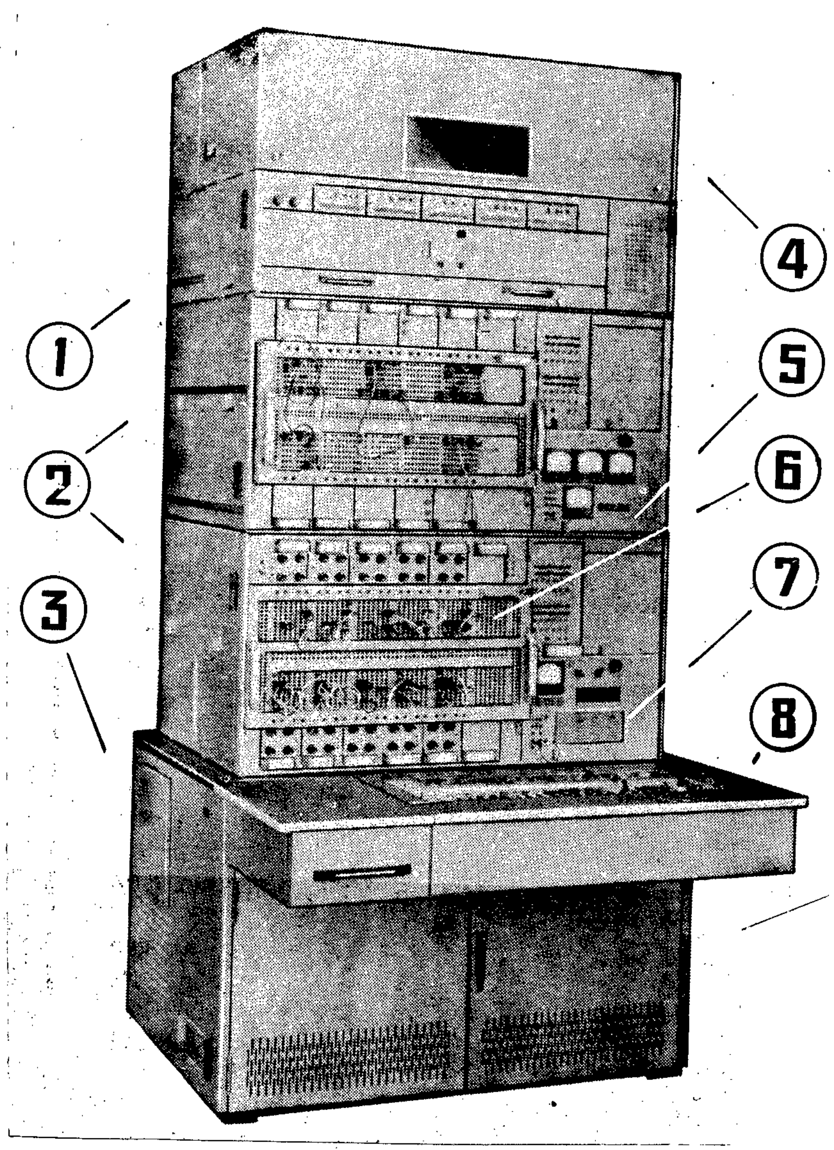
There are instrumentation circuits in the models which provide for a maximum error in setting and measuring the voltage of no more than ±0.015%, referenced to a scale of 100 volts.

Outputs are provided in the models for the connection of peripheral equipment.

The desired quantities are represented in the models by the instantaneous values of DC voltages, which change within a range of from -100 up to +100 volts.

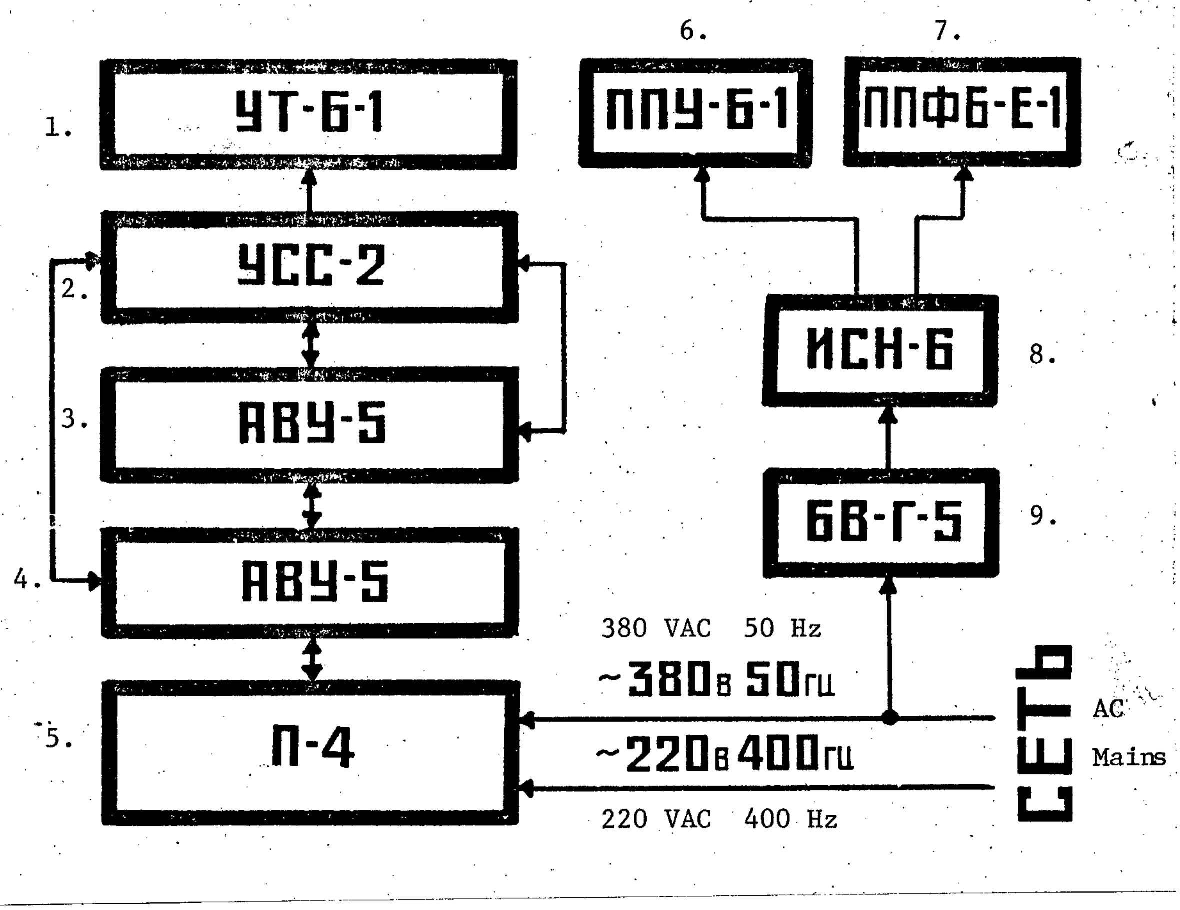
Each model 1, 2, 3 and 4 has overall dimensions of 2,388 x 1,240 x 749 mm, the weight is about 800 kg and occupies an area of 1.6 m^2.

The models are designed for operation under permanent installation conditions at an ambient temperature of 5 - 35° C, a relative air humidity of up to 80% at a temperature of 30° C, an atmospheric pressure of 750 ± 30 mm Hg, and the absence of acid and other aggressive pollutants in the ambient atmosphere.



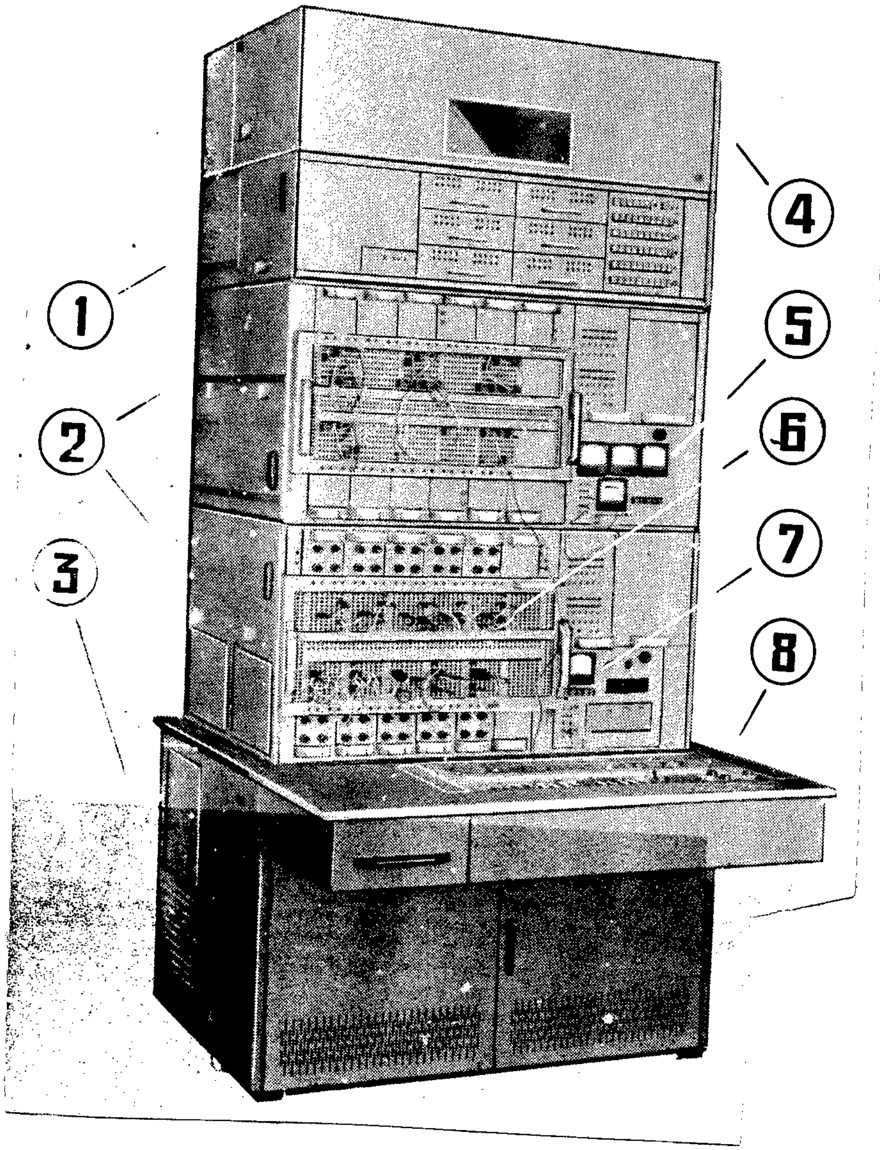
MODEL 1

Key: 1. The USS-2 servo systems unit;
2. The AVU-5 analog computer;
3. The P-4 section control board;
4. The UT-B-1 thermostat control and ventilation unit;
5. The BIP-B-1 metering module;
6. Jack switching field;
7. PVU-B-1 timing and program unit;
8. PU-B-1 section control panel.



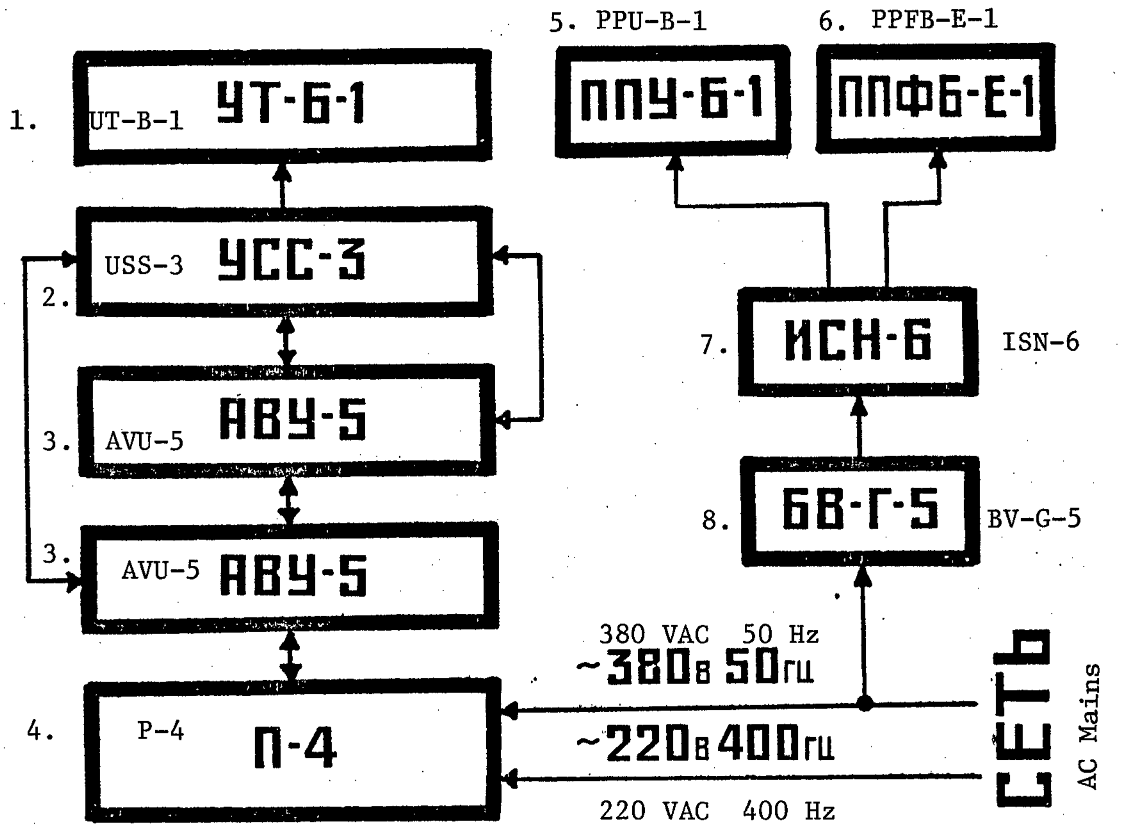
MODEL 1.

Key: 1. UT-B-1, thermostat control and ventilation unit;
2. USS-2, servo systems unit;
3. AVU-5, analog computer;
4. AVU-5;
5. P-4, section control board;
6. PPU-B-1, amplifier check panel;
7. PPFB-E-1, functional module check panel;
8. ISN-6, regulated voltage supply;
9. BV-G-5, rectifier module.



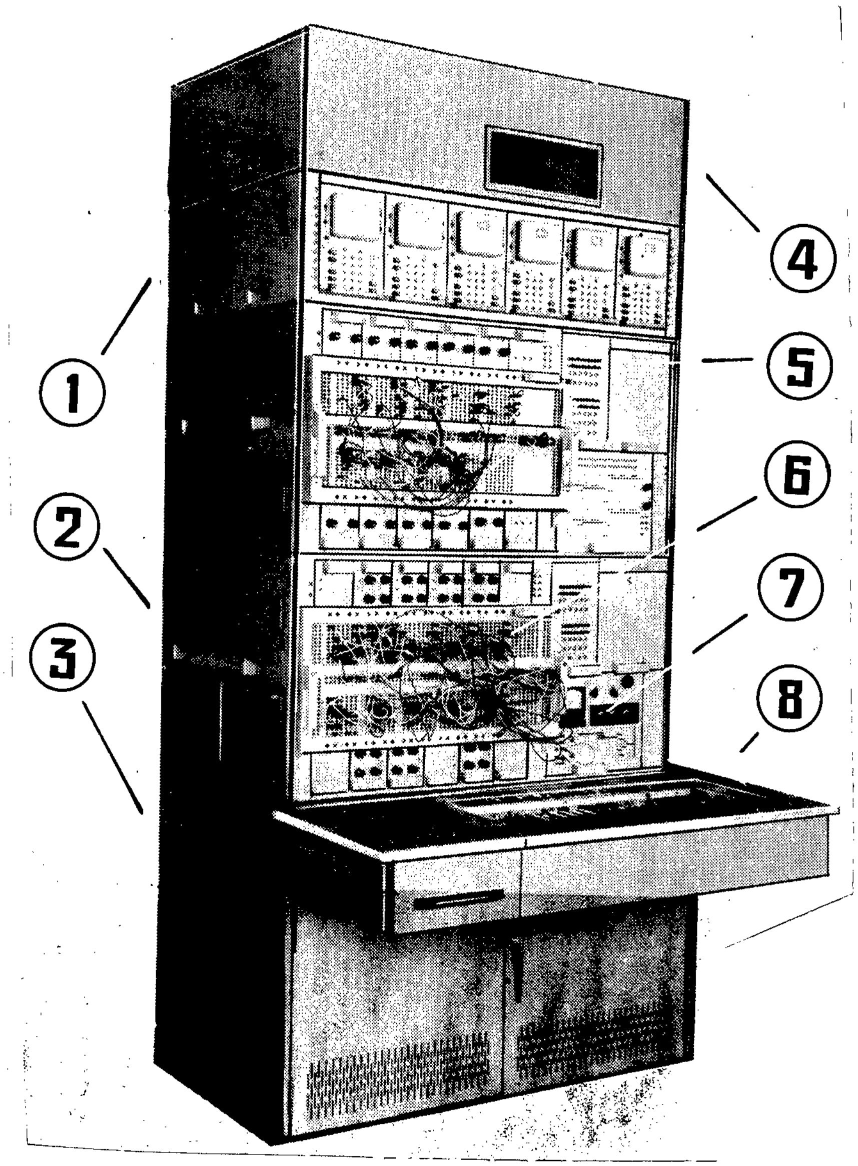
MODEL 2.

Key: 1. USS-3 servo systems unit;
2. AVU-5 analog computer;
3. P-4 control board for the sections;
4. UT-B-1 thermostat control and ventilation unit;
5. BIP-B-1 metering module;
6. Switchboard field;
7. PVU-B-1 timing and program unit;
8. PU-B-1 section control panel.



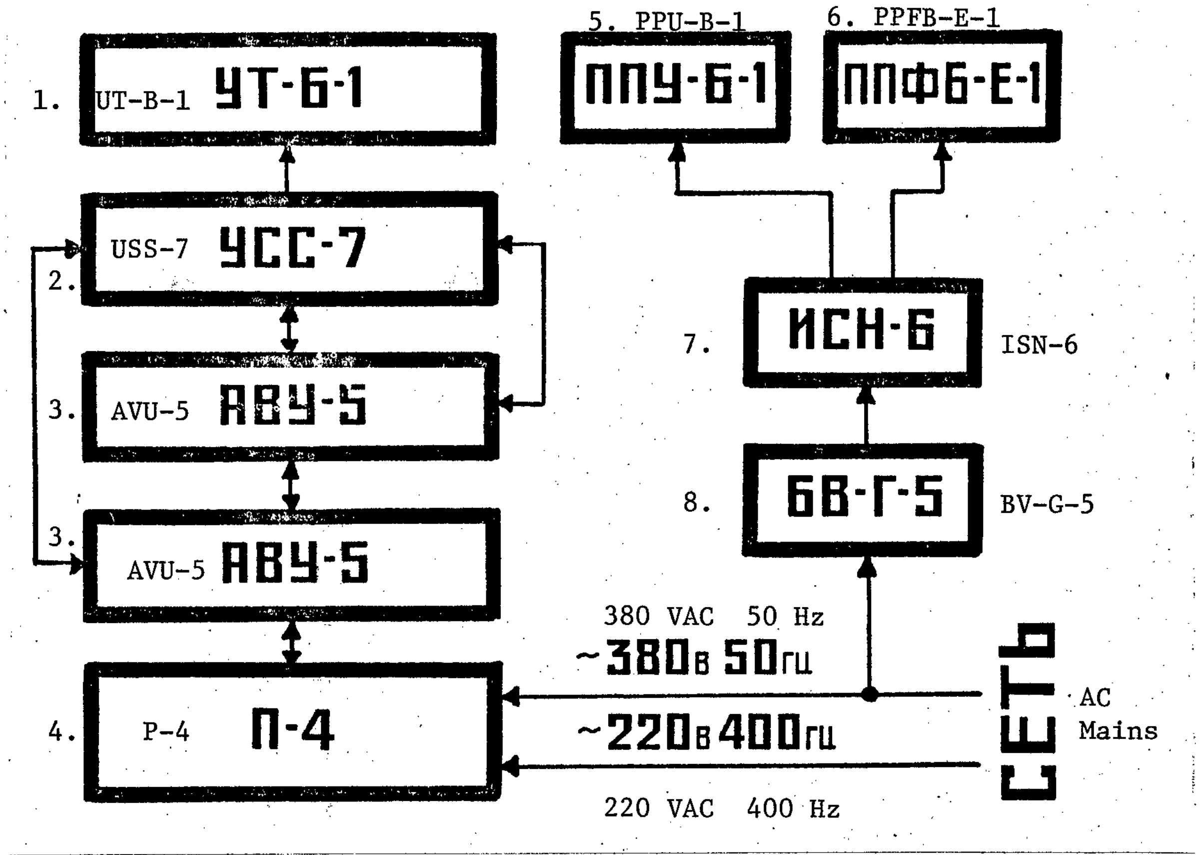
MODEL 2

Key:
1. Thermostat control and ventilation unit;
2. Servo systems unit;
3. Analog computer;
4. Section control board;
5. Amplifier check panel;
6. Functional module check panel;
7. Regulated voltage supply;
8. Rectifier module.



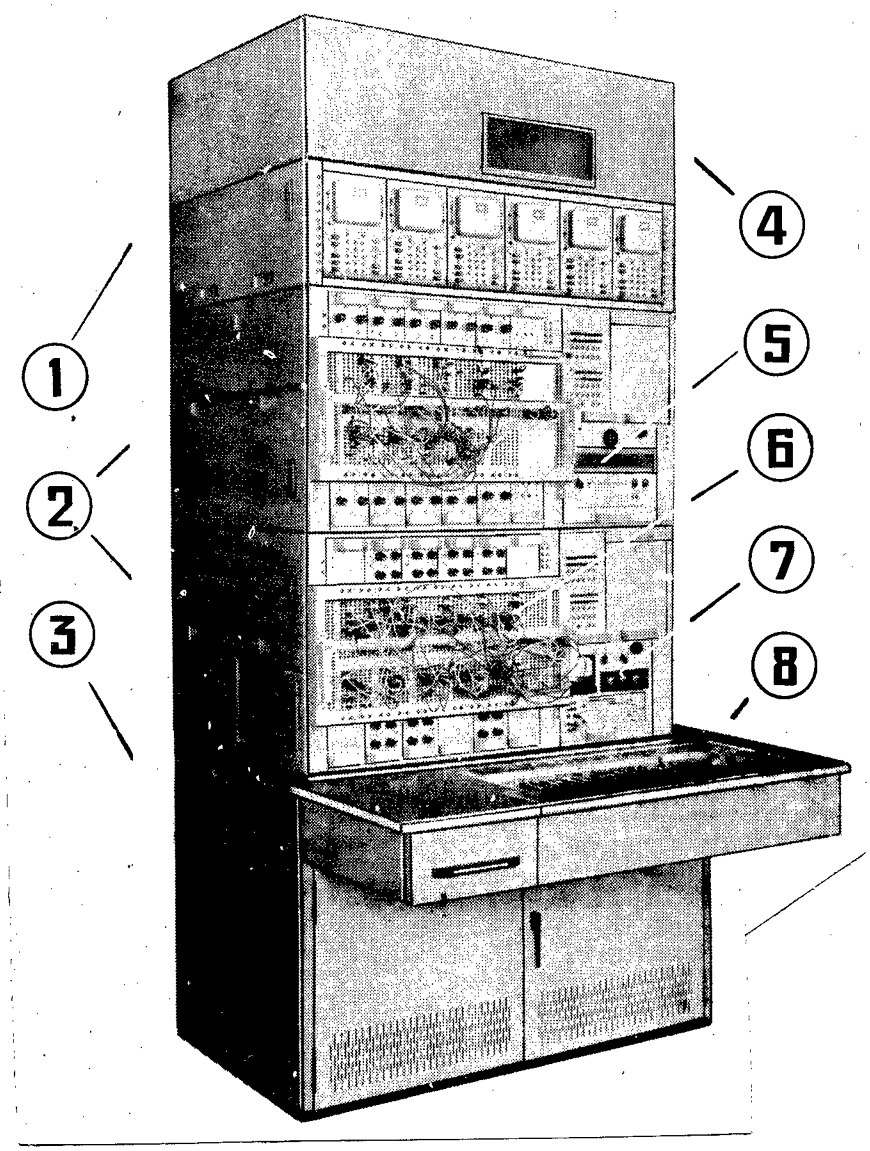
MODEL 3.

Key:
1. USS-7 servo systems unit;
2. AVU-5 analog computer;
3. P-4 section control board;
4. UT-B-1 thermostat control and ventilation unit;
5. BETsV-E-1 digital electronic voltmeter module;
6. Switchboard jack field;
7. PVU-B-1 timing and program unit;
8. PU-V-1 section control panel.



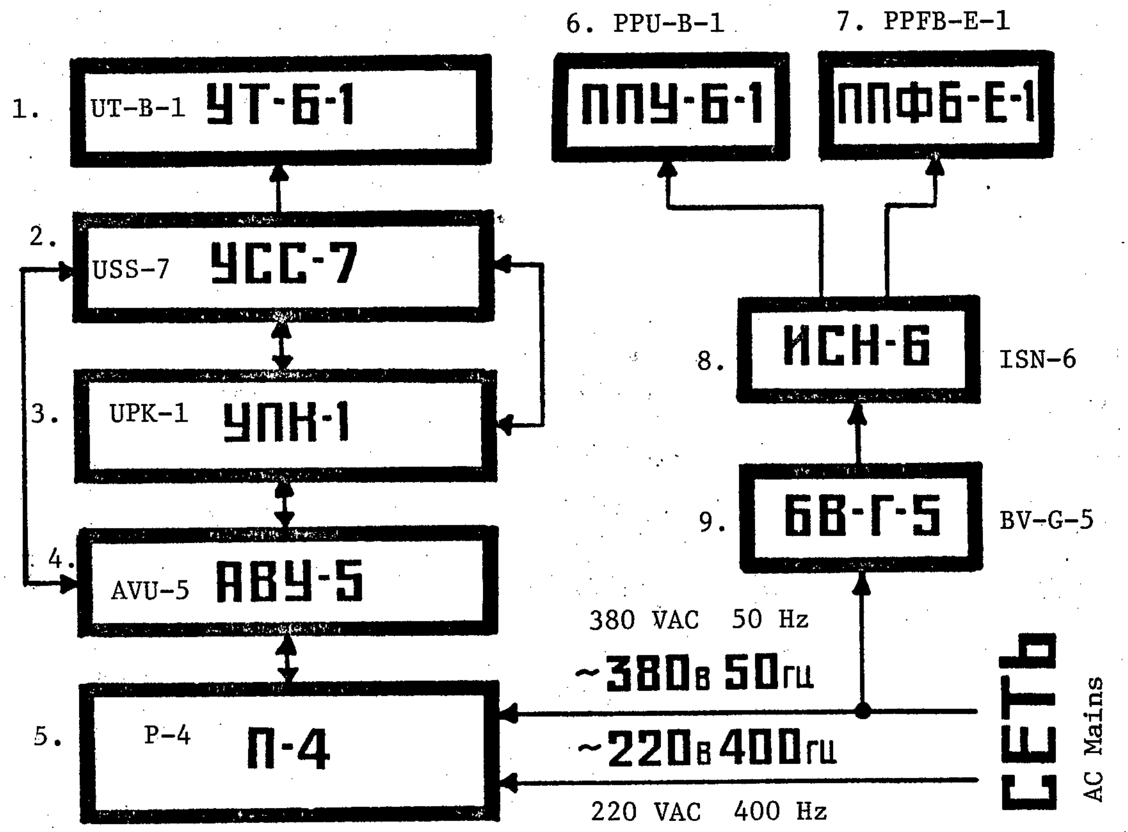
MODEL 3.

Key:
1. Thermostat control and ventilation unit;
2. Servo systems unit;
3. Analog computer;
4. Section control board;
5. Amplifier check panel;
6. Functional module check panel;
7. Regulated voltage supply;
8. Rectifier module.



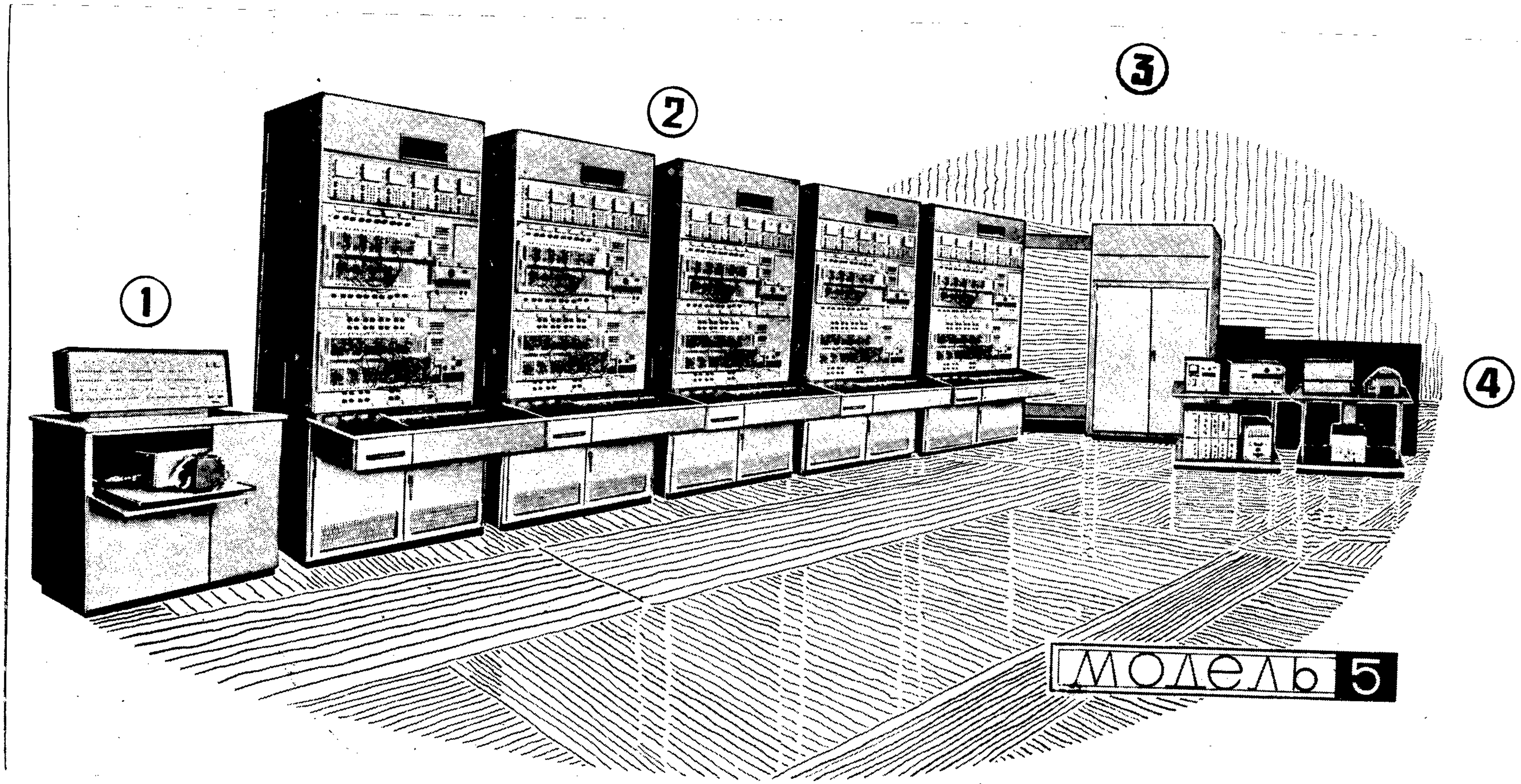
MODEL 4.

Key: 1. USS-7 servo systems unit;
2. AVU-5 analog computer;
3. P-4 section control board;
4. UT-B-1 thermostat control and ventilation unit;
5. UPK-1 variable coefficient unit;
6. Switchboard jack field;
7. PVU-B-1 timing and program unit;
8. PU-B-1 section control panel.



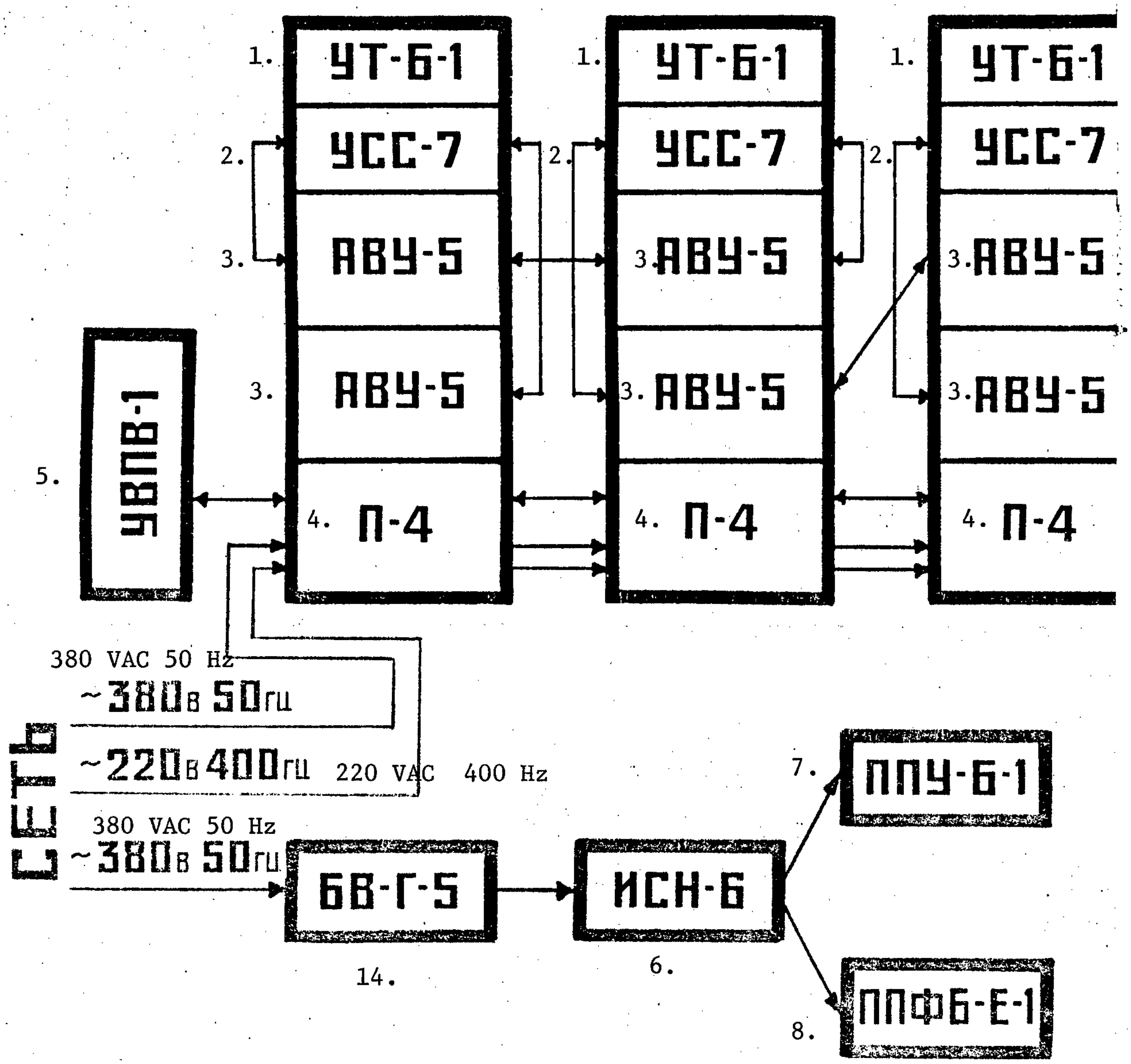
MODEL 4.

Key:
1. Thermostat control and ventilation unit;
2. Servo systems unit;
3. Variable coefficient unit;
4. Analog computer;
5. Section control board;
6. Amplifier check panel;
7. Functional module check panel;
8. Regulated voltage supply;
9. Rectifier module.



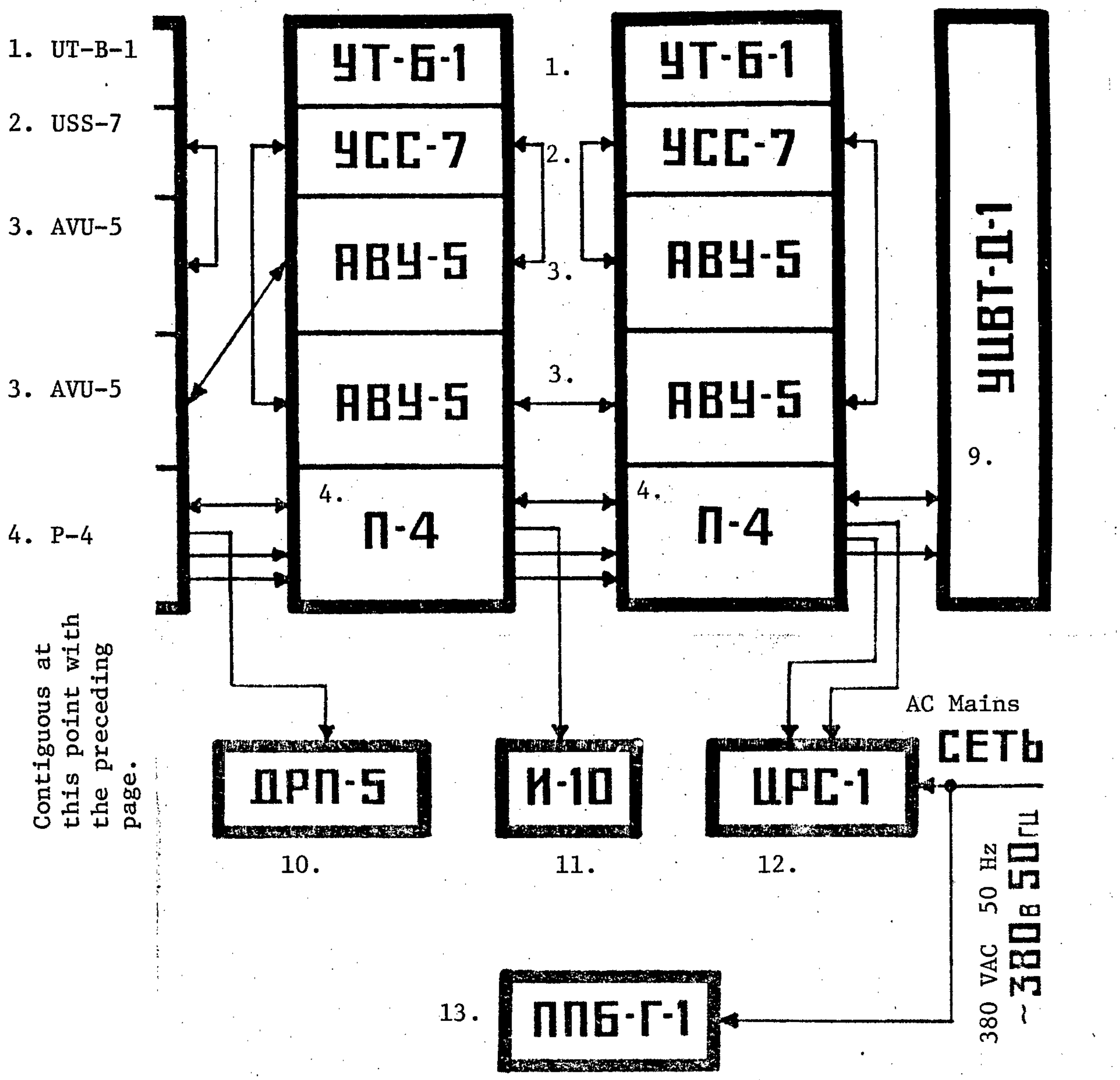
MODEL 5

Key: 1. UVPV-1 quantitative parameter input unit;
2. Model 3;
3. UTsVT-D-1 central thermostat control and ventilation unit;
4. TsRS-1 digital recording system.



MODEL 5. [First half of the power distribution block diagram]

Key: 1. Thermostat control and ventilation unit;
2. Servo systems unit;
3. Analog computer;
4. Section control board;
5. Quantitative parameter input unit;
6. Regulated voltage supply;
7. Amplifier check panel;
8. Functional module check panel;
14. Rectifier module.



MODEL 5.

Key: 1. Thermostat control and ventilation unit;
2. Servo systems unit;
3. Analog computer;
4. Section control board;
9. Centralized thermostat control and ventilation unit;
10. Two coordinate plotter;
11. Display;
12. Digital recording system;
13. Module check panel.

TABLE 1.

Listing No.	Designation of the Units Included in the Complement of Analog Computer Models	Type	Function
1.	Analog computer	AVU-5	The solution of linear and nonlinear differential equations with constant coefficients.
2.	Servo systems unit	USS-2	The reproduction of eight complex nonlinear functions or eight variable coefficients, the execution of 16 multiplication operations.
3.	Servo systems unit	USS-3	The automatic setting of 60 constant coefficients.
4.	Servo systems unit	USS-7	The reproduction of 12 nonlinear functions or 12 variable coefficients, the execution of 24 multiplication operations.
5.	Timing and program unit	PVU-B-1	Setting the time for problem solution, control of logic and peripherals.
6.	Digital electronic voltmeter module	BETsV-E-1	The measurement of DC voltages of different polarities.
7.	Quantitative parameter input unit	UVPV-1	Automatic input from perforated tape of the values of constant coefficients and nonlinear functions, and automatic checking of all functional modules, of the constant coefficients and connections made on the changeable jack fields.
8.	Digital recording system	TsRS-1	Precise tabular form recording of the results of solving problems and fixing the values of constant coefficients during the process of automatically setting them using the UVPV-1.
9.	Centralized thermostat control and ventilation unit	UTsVT-D-1	Maintaining a constant temperature in the compartment for the operational amplifiers and the power supply, and preventing the release of heat from these compartments into the area where the model is set up.
10.	Module check panel	PPB-G-1	Checking all modules of the models.
11.	Amplifier check panel	PPU-B-1	Checking and aligning the amplifiers.
12.	Functional module check panel	PFFB-E-1	Checking and aligning the functional modules.

TABLE 1. [Continued]

Listing No.	Designation of the Units Included in the Complement of Analog Computer Models	Type	Function
13.	Regulated voltage source	ISN-6	Powering the panels and a number of other units.
14.	Thermostat control and ventilation unit	UT-B-1	Maintaining a constant temperature in the functional module compartments.
15.	Section control board	P-4	Control of the analog computer having a complement of from one to ten single section models.
16.	Metering instrumentation module	BIP-B-1	Measurement of DC voltages of different polarities.
17.	Variable coefficient unit	UPK-1	Setting up to 12 variable coefficients using electronic circuits having a high degree of reliability and better time sweep and slope characteristics than provided by the USS-2 and USS-7.
18.	Two coordinate plotter	DRP-5	Recording the problem solution results in the form of graphs
19.	Display	I-10	Observing problem solution results

TABLE 1 [Continued]

[Listing No.]	Power VA	Dimensions, in mm, (for the chassis)	Weight in Kg	Number of Units in the Models: Mod.1	Mod.2	Mod.3	Mod.4	Mod.5
1.	900	1090 x 749 x 535	150	2	2	2	1	10
2.	600	1090 x 749 x 266	80	1	–	–	–	–
3.	220	1090 x 749 x 266	50	–	1	–	–	–
4.	300	1090 x 749 x 266	150	–	–	1	1	5
5.	36	383 x 300 x 242	10	1	1	1	1	5
6.	13	383 x 300 x 242	10	–	–	1	–	5
7.	600	1245 x 510 x 1100	150	–	–	–	–	1
8.	600	1066 x 666 x 752	200	–	–	–	–	1
9.	1750	1200 x 923 x 2407	500	–	–	–	–	1
10.	500	1710 x 850 x 1203	250	–	–	–	–	1
11.	0.4	400 x 305 x 209	5	1	1	1	1	1
12.	–	690 x 470 x 384	12	1	1	1	1	1
13.	430	417 x 450 x 430	30	1	1	1	1	1
14.	1300	1090 x 749 x 282	25	1	1	1	1	5
15.	300	1240 x 1286 x 750	300	1	1	1	1	5
16.	–	383 x 300 x 242	10	1	1	–	–	–
17.	900	1090 x 749 x 535	150	–	–	–	1	–
18.	300	245 x 650 x 576	30	–	–	–	–	1
19.	600	750 x 530 x 1085	110	–	–	–	–	1

TABLE 2

Listing No.	Module Designation	Type	Module Function	Number of Modules in the Particular Models: Mod.1	Mod.2	Mod.3	Mod.4	Mod.5	Remarks
1.	Operational amplifiers (single)		Main solving element	68	68	76	74	368	Two single operational amplifiers form a type U-G-1 module
	Including:								
	Operational computing amplifiers			40	40	52	52	260	
	Auxiliary amplifiers			20	20	20	18	88	
	Spare amplifiers			8	8	4	4	20	
2.	Linear modules	BL-B-2	Performing linear operations: addition, inversion, integration; reprotypical nonlinearities for automatic control systems.	20	20	16	10	80	The module is made with relay switching elements.
3.	Multiplication Modules	BP-D-1	Performing the operations: $Z = \pm 0.01\underline{X} \cdot Y$; $Z = \pm 0.1X^2$; $Z = -10\sqrt{X}$; $Z = -10X/Y$.	8	8	6	4	30	
4.	Nonlinear single variable function modules	BN-B-2	Reproducing single valued continuous functions of the form: $Y = F(X)$.	6	6	8	4	40	
5.	Nonlinear sinusoid modules	BNS-B-2	Reproducing trigonometric functions	4	4	2	2	10	
6.	Nonlinear, two variable function modules	BNF-E-1	Reproducing single valued continuous functions of the form: $Z = F(X \cdot Y)$	-	-	1	-	5	
7.	Electromechanical multiplication modules	BPM-E-1	Performing four multiplication operations, two addition or inversion operations.	-	-	1	-	5	

TABLE 2 [Continued]

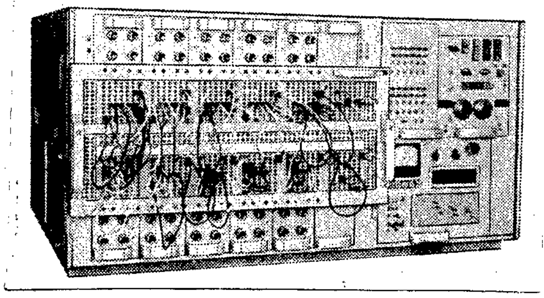
Listing No.	Module Designation	Type	Module Function	Number of Modules in the Particular Models: Mod.1	Mod.2	Mod.3	Mod.4	Mod.5	Remarks
8.	Nonlinear function and constant coefficient modules	BNFPK-E-1	Automatically setting 16 constant coefficients, automatically selecting and reproducing a nonlinear function of a single variable; automatic storage of the function in the process of solving the problem and execution of addition or inversion operations	-	-	4	-	20	Module works together with the UM-9 servo system amplifier. Functions stored during joint operation with the BK-E-1 switching module.
9.	Commutator modules	BK-E-1	Automatically switching over circuits; automatic selection and storage of a function in the problem solution process.	-	-	1	-	5	
10.	Specialized Modules	BSp-B-2	Performing logic operations, reproducing typical nonlinear relationships for automatic control systems	6	6	4	2	20	
11.	Modules for additional connections	BDS-Zh-1	Bringing out the inputs and outputs for the functional modules on one selector field, realizing universal switchover operations when solving problems in linear programming, and performing inversion or addition operations.	-	-	6	-	30	

TABLE 2 [Continued]

Listing No.	Module Designation	Type	Module Function	Number of modules in the Particular Models: Mod.1	Mod.2	Mod.3	Mod.4	Mod.5
12.	Automatic switcher modules	BAK-E-1	Automatic switching of circuits and the execution of inversion and addition operations	-	-	2	-	10
13.	Linear modules	BL-B-4	The execution of linear addition, inversion, and integration operations; reproducing typical nonlinearities of automatic control systems	4	4	-	-	-

Remarks

The module is made with electronic switching elements.



The AVU-5

The AVU-5 analog computer is the basic unit for all AVK-2 models and is intended for solving linear and nonlinear differential equations with constant coefficients.

Basic Technical Data

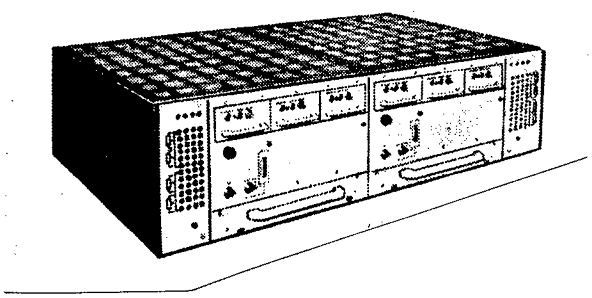
Integration operation duration up to 10,000 seconds.

Maximum integration error* ±0.1%

Maximum error in setting the constant coefficients ±0.02%.

Maximum error in multiplying two variables using the electronic modules ±0.1%.

Maximum error in reproducing hyperbolas at the nodal points using the electronic modules ±0.2%.



The USS-2

Intended for reproducing nonlinear relationships and variable coefficients with a smooth approximation and a large number of extrema, as well as for performing multiplication operations.

Nonlinear functions, $Y_i = f_i(X_o)$, are specified in the form of graphs, cut out in standard millimeter grid paper, and are read by means of photoelectric servo systems.

Basic Technical Data

The number of operations for reproducing nonlinear functions with simultaneous of the form: $Y_i = f_i(X_o)X_i$ is eight.

The number of operations for multiplication of the form: $Y_j = X_o \cdot X_j$ is eight.

The maximum length of the working part of the graph along the X_o axis (scanning the drum) is 300 mm.

The maximum length of the working part of the graph along the Y axis (movement of the optical head of the photoelectric servo system) is 100 mm.

* Here, and later in the text, the maximum error is understood to be the maximum statistical error in percent, referenced to a scale of 100 volts, at a constant temperature.

The maximum permissible graph input speed along the X_o axis is 50 mm/sec.

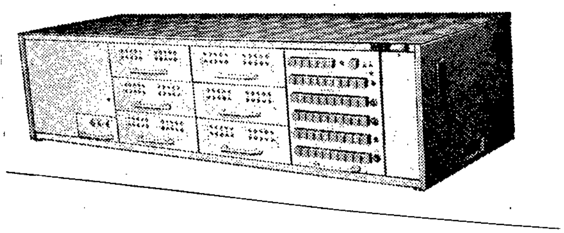
The maximum permissible graph readout speed along the Y axis is 100 mm/sec.

The maximum static error in multiplication ($Y_j = X_o \cdot X_j$) is ±0.3%.

The maximum static error in producing a linear function $Y_i = X_o$ is ±0.5%

The maximum dynamic error in reproducing a linear function $Y_i = X_o$ at the maximum graph input speed along the X_o axis is ±1%.

The maximum slope of the graph which can be read out is 88°.



The USS-3

Intended for performing the operations for automatic remote setting of the values of constant coefficients and initial conditions.

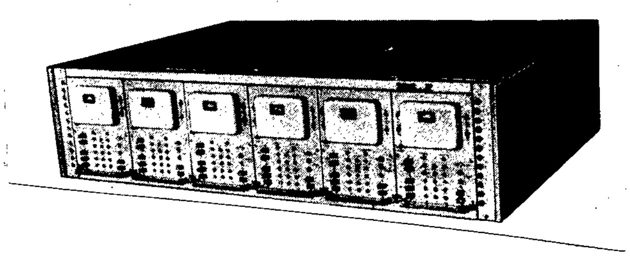
Basic Technical Data

The number of constant coefficients is 60.

The limits for the change of the values of the constant coefficients are from 0.002 up to 0.998.

The maximum time for setting one constant coefficient is 6 seconds.

The maximum error in setting the values of the constant coefficients is ±0.02%.



The USS-7

Intended for reproducing nonlinear relationships and variable coefficients with a smooth approximation, as well as for performing multiplication and inversion operations.

Nonlinear functions, $Y_i = f_i(X_o)$, are specified in the form of graphs, formed by a wire glued onto the plotting paper, and are read by means of operational potentiometers.

Basic Technical Data

The number of nonlinear function reproduction operations with simultaneous multiplication of the form $Y_i = f_i(X_o)X_i$ is 12.

The number of multiplication operations of the form $Y_j = X_o \cdot X_j$ is 12.

The number of inversion operations is 12.

The maximum length of the working part of the graph along the X_o axis is 300 mm.

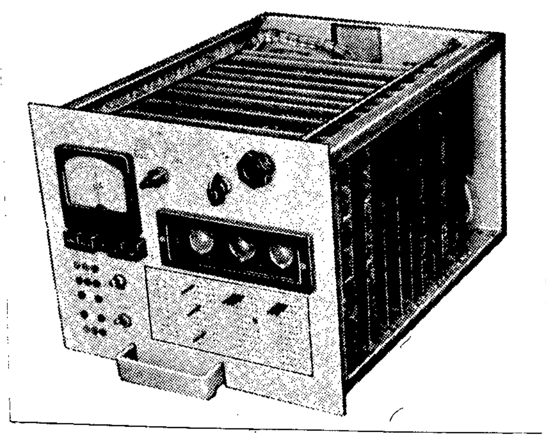
The maximum length of the working part of the graph along the Y axis is 150 mm.

The maximum permissible graph input speed along the X_o axis is 50 mm/sec.

The maximum static error in multiplication ($Y_j = X_o$, X_j) is ±0.3%.

The maximum static error for reproducing the linear function $Y_i = X_o$ is ±1%.

The maximum static error for inversion is ±0.01%.



The PVU-B-1

Intended for setting the start and stop time for integration, and control of the peripherals. The device has two programs for separately triggering the integrators and one program for receiving timing pulses.

Basic Technical Data

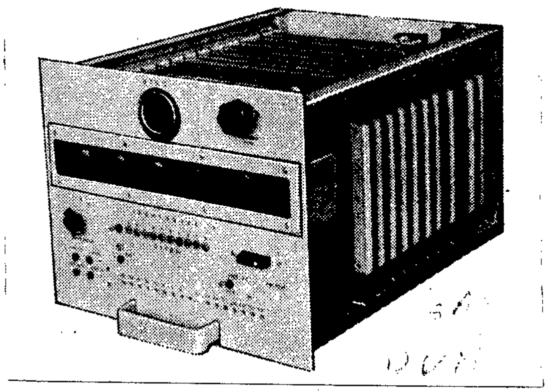
The operational modes of the unit:

- Repetitive operation;
- Repetitive operation with counter reset;
- One-time operation without stopping the counter;
- One-time operation with counter stopping.

The maximum cycle duration, up to 10,000 seconds.

The number of base ten digits in the counter, three.

The maximum time measurement error is ±0.01 %.



The BETsV-E-1

Intended for measuring DC voltages of changing polarities.

The measurement results are represented in the form of a five place decimal number on a light display with simultaneous indication of the polarity of the voltage being measured. The number of the measurement channel is lighted up on the display.

A provision is made in the module for bringing the measurement results out for the purpose of printing them out on an MPU16-2 or for perforation on a PLU-1.

Basic Technical Data

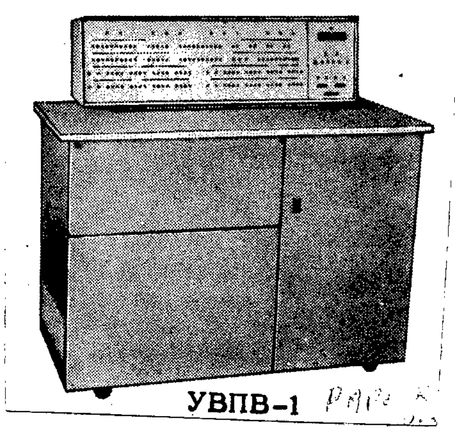
The measurable voltage range is from +105 to -105 volts.

Measurement channels: 1, 5, 10.

The maximum relative DC voltage measurement error when in operation with the equipment complement is ±0.02%.

The input impedance for each measurement channel is 500 KΩ.

The maximum measurement time is 150 msec.



The UVPV-1

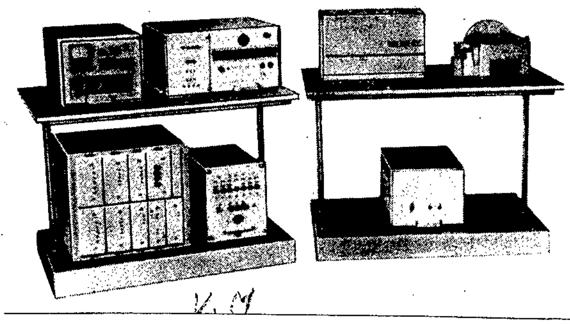
Intended for feeding quantitative parameters from punched tape into the AVK-2 models for automating the steady state monitoring of the AVK-2 models, and for coupling them to the UP-6 conversion unit and a digital computer.

The UVPV-1 consists of two main parts: The PPP-E-1 program preparation board and the quantitative parameter conversion unit, the UPPV-1.

The UPPV-1 permits automatically establishing the constant coefficients, aligning the nonlinearity modules and specifying the operational modes of the AVK-2 from perforated tape or when feeding coded instructions from a digital computer via seven channels.

Information coding is realized on an eight track perforated tape in accordance with GOST [state standard] 13052-67. The unit provides for quantitative parameter input into any of the AVK-2 models.

The program input time for setting one coefficient depends on the number of instructions in the address and the operational readout of the device, and fluctuates within limits of from 0.16 to 5.6 seconds.



TsRS-1

Intended for the precise, automatic measurement of problem solution results, their printout and perforated tape preparation, as well as for recording the values of the constant coefficients and nonlinear relationships in the process of feeding them in using the UVPV-1.

The system is structurally designed in the form of a set of modules and units, which are arranged on two shelves. Included in its complement are:

The ETsV-6 electronic digital voltmeter, which measures the DC voltages with changing polarities;

The MPU-16-2 miniature printer and PLU-1 tape perforator;

The BPI-E-1 information conversion module, which accomplishes the conversion of the incoming information from the ETsV-6 to a form convenient for printout on the MPU16-2 and tape perforating on the PLU-1;

The PVU-B-1 timing and program unit, which sets the program for system operation and effects the temporary clamping of the ordinates being measured for the problem solution being recorded;

The ISN-6 regulated voltage supply and BV-G-5 rectifier module.

Basic Technical Data

Range of measurable voltages, from +105 to -105 volts;

Measurement channels: 1, 5 or 10.

Maximum relative error in measuring the DC voltages at the temperature set for the current converter:

For record modes on the MPU16-2:

On one channel, ±0.02%
On 5 or 10 channels, ±0.05%

For record modes on the PLU-1 tape perforator:

On 1, 5 or 10 channels, ±0.02%

The additional temperature error per 1° C in the temperature range from 5 to +35° C is ±0.005%.

The input impedance for each measurement channels is 500 KΩ.

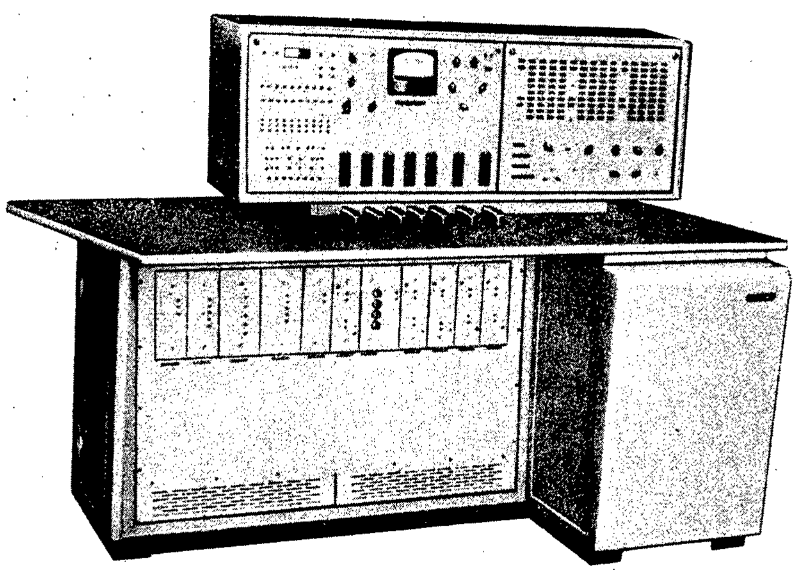
The maximum time for measuring the voltage via one channel and printing out the result on the MPU16-2 is 200 msec.

The maximum time for measuring the voltage via one channel and punching in the result on the PLU-1 is 650 msec.

UTsVT-D-1 [Not pictured]

Intended for maintaining a constant temperature in the compartments of the operational amplifiers and power supplies of the model 5, and preventing the release of heat from these compartments directly into the area where the equipment is set up.

The maximum error in maintaining a constant temperature in the compartments of the operational amplifiers and power supplies of the model is ±5° C.



The PPB-G-1

Intended for checking and aligning all the modules and a number of devices in the complement of the models of the AVK-2 complex.

Basic Technical Data

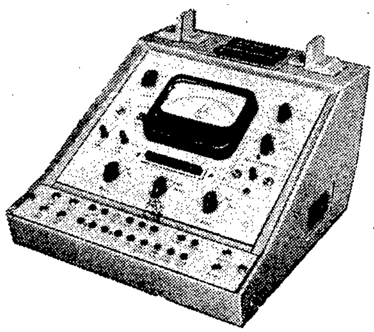
Test voltage transducers: 3.

The range of change in the output voltages of the transducers is from 0 up to ±100 volts in steps of 0.01 volts.

The maximum error in the test voltage transducers is ±0.015%.

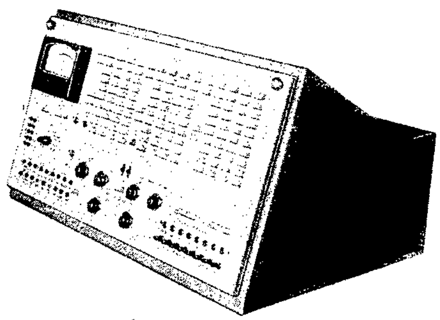
The maximum error in voltage measurement by the compensation method is ±0.02%.

The maximum error in maintaining the temperature in the thermal chamber of the panel is ±1° C.



The PPU-B-1

Intended for checking and aligning the U-G-1 semiconductor amplifiers.



The PPFB-E-1

Intended for checking and aligning the functional modules included in the complement of models of the AVK-2 complex.

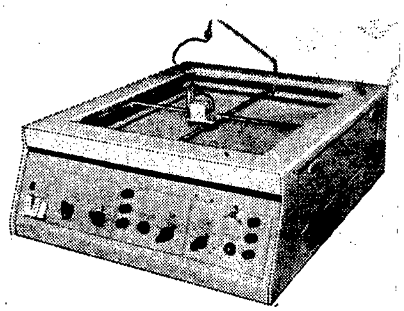
Basic Technical Data

Test voltage transducers: 3.

Range of change in the output voltages of the transducers from 0 to ±100 volts in steps of 0.01 volts.

The maximum error in the test voltage transducers is ±0.015%.

The maximum error in voltage measurement by the compensation method is ±0.02%.



The DRP-5

Intended for automatically plotting graphs on roll and chart paper using the data coming from the model.

The DRP-5 consists of two electromechanical servo systems of a potentiometric type, a table for holding the paper, two tracing pens, a kinematic system, which moves a pen in the plane of the two coordinates, a paper transport mechanism and control circuitry.

A number of circuits and mechanisms are provided to expand the capabilities of the DRP-5:

An internal time sweep circuit, by means of which the X axis is made to move uniformly;

A paper transport mechanism for advancing the chart paper;

Zeroing potentiometers, by means of which the origin of the coordinate of one or both axes of the instrument can be selected at any point on the field of the table.

For convenience in decoding two or more traced curves, two pens are used in the instrument, which are filled with different color inks. The choice of the tracing color and the control of the lifting and lowering of the pens is accomplished from the panel, or by remote control.

Basic Technical Data

The working recording field is 300 x 400 mm.

Measurement limits are ±5, ±10, ±25, ±50, and ±100 volts.

The maximum speed of pen travel along each coordinate is 350 mm/sec.

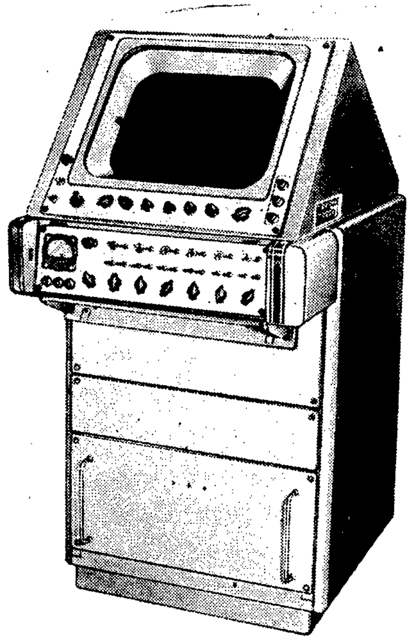
The maximum static error is +0.2%

The variation in the readings (dead zone) is 0.05%.

The input impedance is 50 - 400 KΩ

The internal time sweep rate for the X axis: 1, 2, 5, 10, 20, 50 and 100 mm/sec.

The chart paper transport speed: 1, 2, 5, 10, 50 and 100 mm/sec.



The I-10

Intended for observing AC and DC voltages on the screen of a cathode ray tube. It can be used for simultaneously observing one to six signals on the screen.

The instrument provides for the observation of from one to six signals as a function of time and from one to five signals as a function of any other signal fed to the second input of the display.

Basic Technical Data

The maximum amplitude of observable signals is ±200 volts.

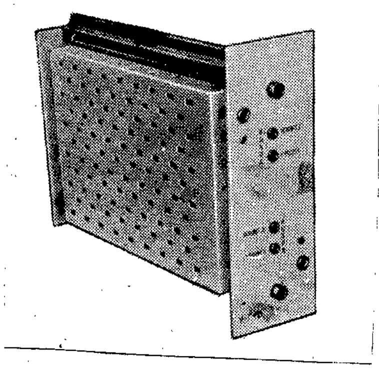
An input signal amplitude of from -200 to +200 volts can be calibrated with an error of ±5%.

Sweep times: 0.01; 0.02; 0.05; 0.1; 0.2; 0.5; 1; 2; 5; 10; 20; and 50 seconds

The repetition period of the time markers is 0.001, 0.01, 0.1, 1 and 5 seconds with a maximum error of ±5%.

The horizontal and vertical display sensitivity is no less than 5 mm/volt.

The nonlinearity in the amplitude characteristics of the vertical and horizontal beam sweep amplifiers is no more than 5%.



The U-G-1

The operational amplifiers, where two of them are structurally combined into one U-G-1 module are intended for operation as the main problem solving elements in a scale unit mode at a given gain of $k = 0$ to 100 in circuits with impedances of R_{in} and R_{inv} of no more than 100 KΩ, and for integration with a time constant of RC = 0 to 10 seconds for an impedance of R_{in} within limits of from 10 to 1,000 KΩ.

Basic Technical Data

The maximum load current is 20 mA.

The DC gain is $5 \cdot 10^6$.

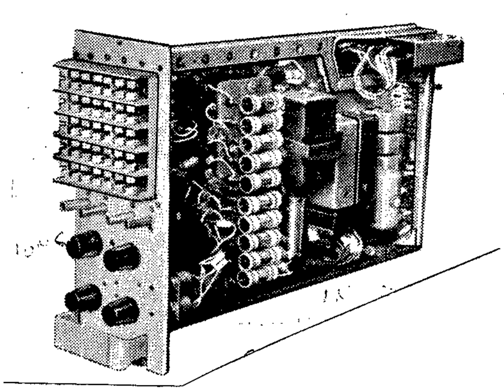
The gain at a frequency of 100 Hz is 10^4.

The timewise drift of the output voltage, referenced to the input, in the scale unit mode does not exceed ±100 μV over eight hours.

The permissible capacitive loads:

At the input: up to 250 pf;

And, at the output, up to 2,000 pf.



The BL-B-2

In conjunction with two DC amplifiers of a U-G-1 module, intended for performing linear operations: summing, inverting, integrating. The linear module permits the reproduction of the typical nonlinearities of automatic control systems (the dead zone, relay characteristics, etc.).

Basic Technical Data

Operations which can be performed:

One summation (with up to 11 input variables) and one inversion;

or two summations (with up to 12 input variables);

or one integration with simultaneous summation (with up to 12 input variables), and one inversion;

or one integration,
and one summation (with up to 13 input variables).

The maximum error in setting the constant coefficients is:

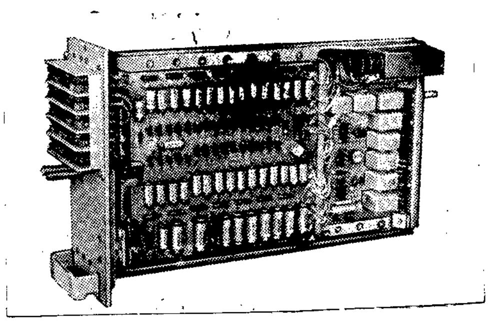
Using the manual potentiometers (4 pots): ±0.02%

Using the potentiometers set by the AVU servo system (4 pots): ±0.05%

The maximum integration error of the zero input voltage over 100 seconds for RC = 1 sec: ±0.01%.

The maximum integration error for a DC voltage of 1 volt over 100 seconds for RC = 1 sec: ±0.1%.

The maximum DC voltage inversion error: ±0.01%.



The BP-D-1

Intended for performing the following operations:

Multiplication, $Z = \pm 0.01\ X \cdot Y$;

Squaring, $Z = \pm 0.01\ X^2$;

Division, $Z = -10\ X/Y$;

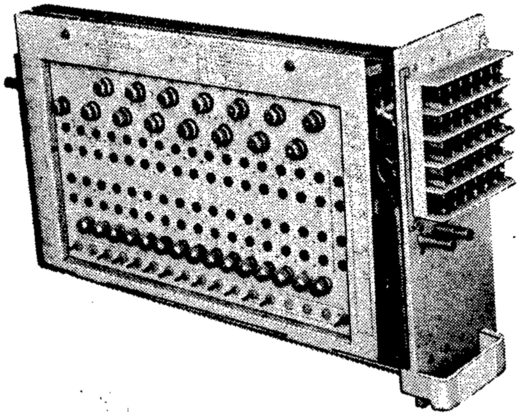
Extracting the square root, $Z = -10\sqrt{X}$

Basic Technical Data

The maximum error in multiplication and squaring: ±0.1%.

The maximum error in division (when the X voltage varies from 0 to ±100 volts, and the Y voltage varies from ±10 to ±100 volts): ±1.5%

The maximum error in extracting a square root (when the X voltage varies from 1 to +100 volts): ±0.2%.



The BN-B-2

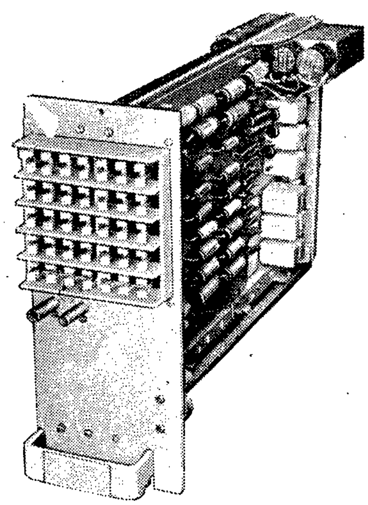
Intended for reproducing a nonlinear, single valued, continuous function by piecewise-linear approximation.

Basic Technical Data

There are 15 approximation intervals.

The maximum slope of a function which can be reproduced by each interval segment is 10 v/v.

The maximum error in reproducing functions at the nodal points (for the hyperbola $Y = 1/X$ when X varies from 0.1 to 1) is ±0.2%.



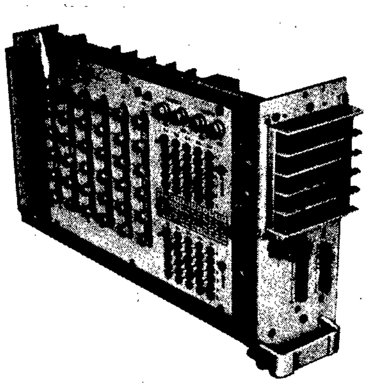
The BNS-B-2

Intended for reproducing trigonometric functions.

Basic Technical Data

The maximum error in reproducing the function
$Y = 100 \sin \frac{\pi}{2} \frac{X}{100}$ is 0.15%.

The maximum error in reproducing the functions:
$Y = 100 \sin \frac{\pi}{2} \frac{X}{100}$, $Y = 100 \cos \frac{\pi}{2} \frac{X}{100}$,
$Y = 100 \cos \pi \frac{X}{100}$ is ±0.25%.



The BNF-E-1

Intended for reproducing single valued, continuous functions of the form: $Z = F(X,Y)$.

Basic Technical Data

The ranges for the change in the input voltages:

From 0 to +100 volts
From 0 to -100 volts
From +100 to -100 volts.

The range of the change in output voltages: from 0 to ±100 volts.

The number of adjustment points in the XY plane: 36.

The discreteness of the points for splitting the ranges of the input variables:

From 0 to +100 volts and from 0 to -100 volts: 10 volts;

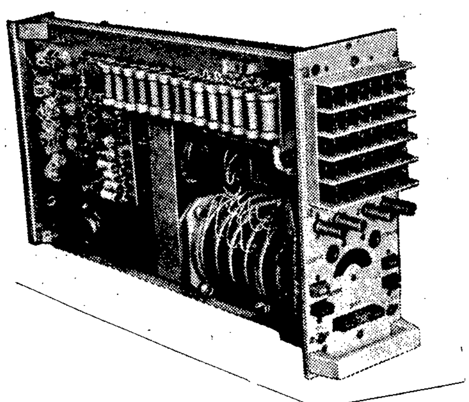
From +100 to -100 volts: 20 volts.

The maximum slope of a reproducible functions for the ranges:

From 0 to +100 volts and from 0 to -100 volts: 5 v/v;

From +100 to -100 volts: 2.5 v/v

The maximum error in reproducing the test function is ±2%.



The BPM-E-1

Intended for performing multiplication operations, as well as in conjunction with the two DC amplifiers of a U-G-1 module, for performing linear summation and inversion operations.

The module is designed around a potentiometric servo system.

Basic Technical Data

Operations which can be performed:

Four multiplications of the form $Y_j = 0.01\ X_o \cdot X_j$ (where j = 1, 2, 3, 4);

One summation (with up to 11 input variables) and one inversion,

Or, two summations (with up to six input variables),

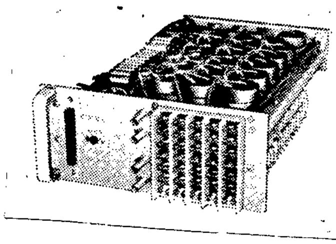
Or two inversions.

The maximum permissible frequency for the change in the variable X_o is 0.5 Hz.

The maximum permissible frequency for the change in the variable X_j is 1,000 Hz.

The maximum static multiplication error is ±0.3%.

The BNFPK-E-1



Intended for performing the following operations jointly with the UM-9 servo system amplifier: automatic remote setting of the constant coefficients, specifying the initial conditions, and the automatic selection and reproduction of a nonlinear function of one variable. The module provides for automatically storing the function in the process of problem solution, working in conjunction with the BK-E-1 switchboard module.

In conjunction with the two DC amplifiers of the U-G-1 module, the module provides for performing linear summation and inversion operations.

Basic Technical Data

Some 16 operations for constant coefficient setting;

One operation for setting and reproducing and nonlinear function of one variable;

One summation operation (with up to 9 input variables);

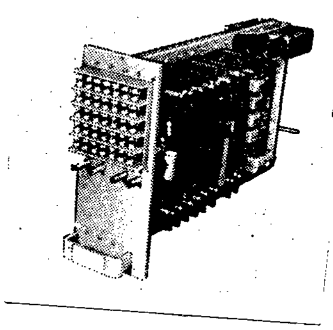
And one inversion operation, or two summation operations (with up to 9 input variables), or two inversion operations.

The maximum error in setting the constant coefficients is ±0.02%

The maximum time for setting a constant coefficient is 5 seconds.

The maximum error in automatically selecting and reproducing a nonlinear function is ±0.2% at nodal points.

BSp-B-2



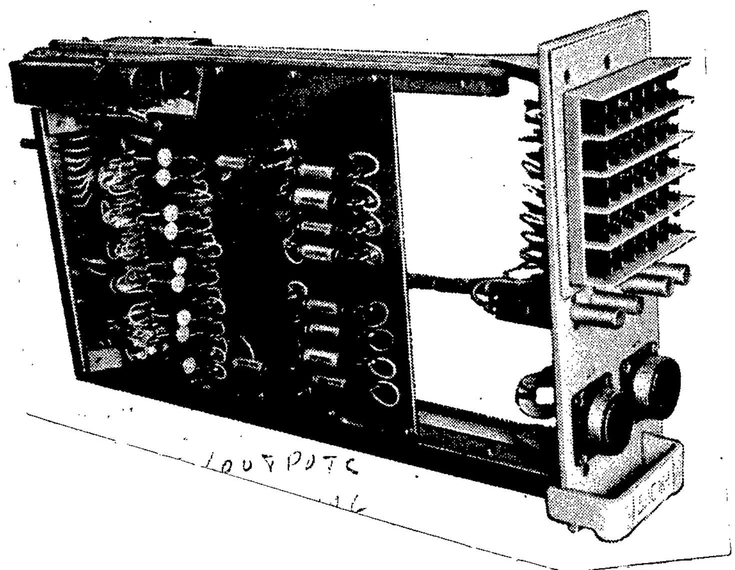
Intended for performing logic operations, and for reproducing the standard nonlinear relationships of automatic control systems.

Included in the module are:

One comparison gate;
One limiter circuit;
One circuit for choosing the maximum;
One circuit for choosing the minimum;
Two diode switches;
One complementing and setting input flip-flop;
One single-shot multivibrator;
One "NOT" gate;

Seven relays;
Four polarized relays.

The components and circuits of the module are mounted on interchangeable circuit boards (the number of circuit board places is 10).



BDS-Zh-1

Intended for bringing out the inputs and outputs of the functional modules and devices on one selector field, making universal switched connections when solving linear programming problems, as well as for performing linear inversion and summation operations in conjunction with the two DC amplifiers of the U-G-1 module.

Basic Technical Data

The number of coupling circuits brought out on the selector field: 60.

The operations which can be performed:

Summations (with up to four input variables), 2, or inversion, 2.

The maximum inversion error is ±0.01%.

The BK-E-1 [Not pictured]

Intended for automatically reswitching circuits and for automatically selecting and storing a function during the problem solution process.

Included in the module are:

One counter with a decoder having 16 output buses;
Four flip-flops with complementing and setting inputs.

Two single-shot multivibrators;
Two "NOT" gates;
Four 4-input "OR" gates.

The BAK-E-1 [Not pictured]

Intended for automatically switching and reswitching the output and input circuits of the amplifiers, the circuits of potentiometers and other solution circuitry. The module contains two relay switching matrices, each of which provides for 8 x 9 switched connections.

In conjunction with the two DC amplifiers of the U-G-1, the module provides for the execution of two inversion operations or summation operations (up to 10 input variables) or one summation operation (up to 9 input variables) and one inversion operation, in addition to the operations indicated above.

The ISN-6 [Not pictured]

Intended for powering the PPU-B-1 and PPFB-E-1 panels, the TsRS-1 system and the UVPV-1 unit where the latter operates independently. Included in the ISN-6 complement are the following modules: the BSN-G-1 (+200 and 27 volts); the BSN-G-2 (120 volts); the BSN-G-3 (±6.3 and -27 volts) and the source of calibrating voltages of ±100 volts.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

MOSCOW'S SCIENTIFIC RESEARCH INSTITUTIONS TO BECOME MODELS

Moscow MOSKOVSKAYA PRAVDA in Russian 18 Sep 76 pp 1, 3

[Article: "Model Scientific Institutions for a Model City"]

> [Text] A conference of the aktiv of Moscow's scientific institutions was held yesterday to discuss the problem connected with the "Tasks of the Party Organizations and Collectives of Scientific Research and Planning Institutes and Designing Offices To Transform Scientific Research Institutes and Designing Offices Into Model Scientific Institutions and To Increase Their Contribution to the Solution of the Basic Socioeconomic Problems of the Capital's Development." The conference was opened by V. N. Makeyev, secretary of the Moscow Municipal CPSU Committee. Speakers at the conference were N. S. Babayev, party committee secretary of the Atomic Energy Institute imeni Kurchatov; V. I. Usenin, department head of the Institute of the International Worker Movement of the USSR Academy of Sciences; A. V. Sidorenko, vice president of the USSR Academy of Sciences; V. M. Mel'nikova, party bureau secretary of the Scientific Research Institute of Traumatology and Orthopedics imeni Priorov; N. M. Voronichev, chief of the Moscow Special Designing Office of Automatic Lines and Unit Machine Tools; N. P. Lyakishev, department chief of the Central Scientific Research Institute of Ferrous Metallurgy imeni Bardin; and N. P. Mel'nikov, director of the Central Scientific Research and Planning Institute Proyektstal'konstruktsiya. A speech was delivered at the conference by V. V. Grishin, first secretary of the Moscow Municipal CPSU Committee.

A struggle for carrying out the decisions of the 25th Party Congress and for carrying out a national task of historical importance -- that of transforming Moscow into a model communist city, the workers' capital -- is under way with increasing activeness and on an ever-broader scale. The General Secretary of the

CC CPSU, Comrade Leonid Il'ich Brezhnev,noted with satisfaction in his brilliant, profoundly reasoned speech at the conference of the party and economic aktiv of Kazakhstan that revolutionary creative spirit and the ideas of the 25th congress live in the daily affairs of our party and our people. N. S. Babayev, party committee secretary of the institute imeni Kurchatov said that a convincing confirmation is the many patriotic initiatives generated in the course of socialist competition for the successful realization of the socio-economic program of the Tenth Five-Year Plan.

Advanced collectives of the industry, transportation, construction, municipal economy, trade, services, public education, and public health of our city have been the initiators of the movement for transforming their enterprises and institutions into model ones. The competition for model microrayons has also obtained the broad support of the Muscovites. The significance of their initiative is very great; they are of major economic importance. That is why in supporting these patriot initiatives, communists and the entire collective of the institutes imeni Kurchatov have unanimously approved the decision to step up work to transform the institute into a model scientific research organization of the capital.

The historic task of transforming Moscow into a model communist city is at the center of attention of the municipal party organization. Social scientists are also required to make their contribution to its solution, said V. I. Usenin, department head of the Institute of the International Workers Movement of the USSR Academy of Sciences, from the forum. We consider it a matter of honor for the Moscow research institutes to become a criterion for determining the effectiveness of scientific work, the yardstick of its policy. To be called a Moscow scientist is a great honor. Moscow's scientific institution should come forth with an initiative to battle for raising strictness for the right to be called a scientific employee, for enhancing the authority of scientific titles. It is necessary to be more decisive in using the system of certifications and competitions, to recruit the more able for scientific work.

Every scientist in the field of the social sciences is an employee of the ideological front. In reality, only a specialist standing firmly on party positions and analyzing the phenomena of contemporaneity from these positions can actually develop Marxist-Leninist science. All our work, the labor of every Soviet social scientist, must be permeated with the spirit of party-mindedness.

A most important task of the USSR Academy of Sciences is to continue the work to prepare a comprehensive program for scientific technical progress and its socioeconomic consequences, academy Vice President A. V. Sidorenko said in his speech. The work on the comprehensive program done by the academy in conjunction with ministries and agencies was noted by Comrade L. I. Brezhnev at the 25th CPSU Congress. Moscow institutes have also made a significant contribution to it.

Moscow's scientific institutes are in the first rank of those scientific collectives of the USSR Academy of Sciences that have widely extended

socialist competition. One of the characteristic forms of this movement in the Tenth Five-Year Plan involves competition for transforming institutes into model scientific institutions.

The Presidium of the USSR Academy of Sciences is devoting much attention to raising the effectiveness and quality of scientific research in the activity of institutes, to developing creative amity with industrial enterprises, primarily with those of Moscow and with sectoral institutes, and to accelerating the introduction of scientific results in the national economy.

Such a form of science's ties with production as contracts on the creative amity of scientific institutions with industrial enterprises is being developed. For instance, the Metallurgy Institute imeni Baykov has for many years been maintaining creative ties with the Machine Tool-Building Plant imeni Ordzhonikidze, the Moscow Motor Vehicle Plants imeni Likhachev and imeni Leninist Komsomol and with other collectives. The Presidium of the Academy of Sciences devotes much attention to generalizing and disseminating the experience of the scientists' successful cooperation with the employees of production.

The collective of the Central Institute of Traumatology and Orthopedics imeni Priorov has welcomed with great patriotic enthusiasm the decisions of the 25th party congress, Professor V. M. Mel'nikova, institute party bureau secretary, said in her speech. The slogan of the Tenth Five-Year Plan -- effectiveness and quality -- is also applicable to the work of scientific institutions.

The practical realization of scientific ideas and the rapid introduction of the accomplishments of scientific technical progress are no less important than their elaboration. Our collective is today working under the slogan "A model scientific research institute for the model communist city." Heightened socialist obligations have been assumed for the Tenth Five-Year Plan, and a plan for the socioeconomic development of the institute until 1990 has been drawn up.

The institute did much work in the Ninth Five-Year Plan to provide practical assistance to Moscow. The newest methods of treatment developed at the Central Institute of Traumatology and Orthopedics imeni Priorov are being introduced through municipal hospitals, polyclinics, and dispensaries, where our professors work. The institute's permanent clinic bases are municipal hospitals Nos 33 and 59 and imeni Botkin.

In battling for a model scientific research institute, we will further improve our work to provide assistance to the capital's public health. However, the crux of the matter now involves creative amity, and to this end we are concluding a contract with the Public Health Administration of the Moscow Municipal Executive Committee.

Worked up in the collective of our office has been a "Program of Action in the Tenth Five-Year Plan to Transform the Organizations Into a Model Organization of Engineering and Designing Labor in Terms of High Scientific

Technical Level, Quality of Elaborations, Ensurement of the High Creative and Socio-Political Activity of Those Working, and the Creation of Contemporary Working, Living, and Leisure Conditions," N. M. Voronicheva, chief of the Special Designing Office of Automatic Lines and Unit Machine Tools, said in her speech. The draft program has been discussed and adopted at the party and economic aktiv. It should be said that a majority of the measures envisioned by our program are closely connected with the work of the head plant, at which our plans are being realized. The head plant is the Machine Tool-Building Plant imeni Ordzhonikidze. Solid production friendship and cooperation have existed for many years between the special designing office and the plant.

We know that the realization of the program will entail much and persistent work; however, we hope that we will do it and thereby make our contribution to the successful execution of the decisions of the 25th congress and to the transformation of our capital into a model communist city.

The accomplishment of the task posed by the General Secretary of the Central Committee of our party, Comrade Leonid Il'ich Brezhnev, on transforming Moscow into a model communist city, is one of the basic directions of the activity of the party and economic bodies, a matter of honor for every inhabitant of the capital, said a department chief of the Central Scientific Research Institute of Ferrous Metallurgy imeni Bardin, N. P. Lyakishev. We have established exceptionally broad and fruitful creative ties with many Moscow enterprises. We are successfully cooperating with the Serp i Molot Plant, a tube plant, the Motor Vehicle Plant imeni Likhachev, and other collectives.

The institute's party organization, having discussed the initiative of the city's advanced enterprises and organizations, has made a decision to widely extend work to transform the institute into a model enterprise in terms of effectiveness and quality of research, equipment availability, the posing of ideological and indoctrination work, and the solution of social problems. We at the beginning of the year worked up an integrated plan for the scientific technical and social development of the institute for the 1971-80 period.

In understanding the necessity and state importance of the upcoming work, we get a distinct idea of the difficulty and complexity that we will have to surmount. The institute's party, trade union, Komsomol, and public organizations will have to do daily stepped-up and laborious work. It is necessary to reach every member of the collective, all the areas of his labor and public life.

Sixty scientific research and planning organizations of Cheremushkinskiy Rayon are doing stepped-up scientific research and designing work under the slogan "A model institute for the model city," N. P. Mel'nikov, director of the Central Scientific Research and Planning Institute Proyektstal'konstruktsiya, noted from the forum of the aktiv.

Becoming a model institute means essentially raising scientific technical potential, conducting a search for new and the most up-to-date ideas, accelerating the introduction of the results of scientific research and hence achieving significant technical and economic results in raising the effectiveness of production and construction. This means working on raising the ideological and professional level of the collective of scientists, strengthening the base of the institutes, and improving the working and living conditions of the employees.

Evolved in this rayon has been a specific system of relations between science and production, which system is under the continuous control of the rayon CPSU committee and which has been ever-increasingly expanded and deepened over 3 years.

The assumption of creative obligations has been widely disseminated in the scientific collectives of the rayons, as has the conclusion of contracts on the creative amity with the enterprises of Moscow's industry, transportation, and construction. These contracts are directed at providing practical assistance to the enterprises in transforming them into model ones.

It was stressed at the conference of the aktiv that in carrying out party policy, the municipal party organization sees to it that the solution of current problems of the capital's development are combined with the realization of the task to make it a model communist city. For Muscovites, it is the concrete embodiment of the party's economic strategy both for the Tenth Five-Year Plan and for the longer haul.

The program elaborated for transforming the city into a model one is being realized in a persistent way. Positive results have been achieved in developing the productive forces on the basis of scientific technical progress, the fuller satisfaction of the citizens' variegated material and cultural requests, education, and the revelation of the abilities and best moral characteristics of the people.

The initiative of the advanced collectives of physical production and of services, which have decided to make their enterprises and institutions model ones, has constituted an expression of the high conscientiousness of the workers and their aspiration to make their own concrete contribution to the common cause. This initiative is of major significance, since it is impossible to transform Moscow into a model city without making all its enterprises, institutions, including the educational variety, services for the public, and construction into model ones, without making residential buildings, apartments, streets, microrayons, and entire rayons model ones.

The initiative of the advanced collectives of industry and transportation has been supported widely. Workers, engineering and technical personnel, and employees of production associations, plants, factories, and transport organizations are being actively included in the movement for transforming every Moscow enterprise into a model one.

Employees of the other sectors of the capital's economy have stepped up the struggle to transform their enterprises and institutions into model ones. The collectives of many higher educational institutions, tekhnikums, and other educational institutions, trade enterprises, and cultural and public health institutions have assumed concrete obligations and organized their fulfillment. Construction workers are included in this movement.

Of major significance is the initiative of the advanced collectives of scientists and designers to make the capital's scientific institutions model ones.

Moscow is the site of the basic scientific research, planning, and designing organizations determining technical policy and the developmental prospects of many sectors of the country's economy. They have done important scientific work and made important discoveries; in amity with the employees of plants and factories, they have developed many new types of machines, machine tools, instruments, materials, models of radio equipment and electronic computers, and consumer goods. Their activity is to a large extent contributing to raising the country's economic potential and improving the standard of living of the Soviet people.

The major and complex tasks of the contemporary stage of communist construction, it was said at the conference, require further enhancing the role of science both in the matter of scientific technical progress and in the solution of social problems. Profound studies of processes and phenomena are necessary, as are a thoughtful analysis of the problems and responsible recommendations for their solution. Scientists and designers must actively and purposefully work on developing future technology. Science is required to help the party in educating the people and to contribute to the all-round development of the personality.

Science's business ties with production and with practice and the all-round assistance of scientists and designers in developing all sectors of the capital's economy, in solving economic and social problems, and in improving the communist education of the workers constitute an indispensable condition for transforming the capital into a model communist city. Moreover, the tightening and expansion of ties with production are a necessary condition for improving the work of the scientific research and planning and designing organizations themselves.

Moscow's scientific institutions are as a whole coping successfully with their tasks. They have favorable conditions to this end. However, it was stressed at the conference, it is impossible not to see the shortcomings in the work of some scientific research institutes and designing offices. These shortcomings are the poor effectiveness of their activity, the low scientific and engineering level of some developments, the lag behind the requirement of practice, the poor use of scientific potential, and the low return in work.

The broad unfolding of the work to reach the level of model ones and the involvement therein of all members of collectives constitute an effective means for raising the effectiveness and quality of research and planning and designing matters.

In proceeding from the experience of advanced collectives, it is possible to formulate the basic demands with which the model scientific institution must accord.

A main condition for the transformation of a scientific institution into a model one, it was said at the conference, involves the successful fulfillment of thematic plans and assignments, accomplishments in the solution of the basic problems of science and technology, the effective organization of research, the high quality of all work, and a reduction in the time needed to realize completed developments.

The model scientific institutions must be closely connected with production, with practice, help enterprises and institutions solve the tasks confronting them. Academic institutions are required to contribute to raising the scientific level of the work of sectoral institutes.

A most important integral part of the work to transform scientific institutions into model ones involves stepping up the education of people. Given the conditions of the contemporary scientific technical revolution and the economic competition of the two world systems, the significance of ideological work among the scientific technical intelligentsia and its indoctrination in the spirit of the Marxist-Leninist world view, intolerance for bourgeois ideology, and devotion to the cause of the Communist Party increases immeasurably. The results of all scientific activity hinges largely on the ideological maturity of the scientific technical intelligentsia, on its correct understanding of its role and place in Soviet society and its responsibility to the party and people.

Directed to this end, it was stressed at the conference, must also be the indoctrination work of party organizations constructed on the basis of a profound study of advanced revolutionary theory. The mastery by all scientific employees of Marxist-Leninist methodology and the ability to apply it in work constitute an important factor for raising the effectiveness of scientific research and for improving all activity of the scientific research institutes and designing offices.

The discussion at the conference involved the fact that the task of transforming Moscow's scientific research and planning and designing institutions into model ones is a complex and crucial one. So as to achieve the model level, it is necessary to do much organizational and educational work. It is important that every labor collective, all party, trade union, and Komsomol organizations, and the heads of scientific research institutes and designing offices be included actively in the struggle for the achievement of this goal. It is necessary, with the involvement of the aktiv at large, to draw up concrete plans of measures to transform scientific institutions into model ones, to determine what material and technical and other means are needed to this end. The most important thing is to channel the efforts of all members of the collective into realizing the intended plans.

Conference participants expressed assurance that the initiative of the advanced collectives, which have extended work to transform their institutions

and organizations into model ones, will obtain the approval and warm support in every scientific research and planning institute and in every designing office.

In concluding, conference participants adopted an appeal in which they assured the Central Committee of the Communist Party of the Soviet Union that the capital's scientists and designers will apply all their knowledge, energy, and experience for the successful fulfillment of the majestic plans of the 25th CPSU Congress and for the further flourishing of Soviet science and make a worthwhile contribution to the transformation of Moscow into a model communist city.

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